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ABSTRACT

These two interim reports are the third and fourth in a series based on data from the 1,082 microcomputer-owning public and non-public elementary and secondary schools that responded to a survey of 1,600 schools (68%) between December 1982 and March 1983. Issue No. 3 presents comparable data on microcomputer ownership and use for schools in different regions and in cities, suburbs, and rural locations; for junior high and middle schools in comparison with elementary and high schools; and for schools serving students of varied socioeconomic backgrounds. Issue No. 4 focuses on the different patterns that schools have used to obtain microcomputers: the initiative of a single teacher, the effort of a building principal, the role of parent-teacher organizations, the leadership of school district and other school administrative personnel, and financial assistance from special grant programs. Data show how schools have changed in the way they have obtained microcomputers and how they have organized their use by students. (LMM)

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School Uses of Microcomputers: Reports From a National Survey

Issue No.3, October 1983
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School Uses of Microcomputers

Reports from a National Survey

Issue No. 3, October 1983

Center for Social Organization of Schools — The Johns Hopkins University

Focus of this Issue: How School Ownership and Use of Micros Varies by Region of the Country, Urbanization, Type of School, Socio-Economic Status, and Race

This issue presents comparable data on ownership and use of microcomputers for schools in different regions of the country and in cities, suburbs and rural locations; for junior highs and middle schools in comparison to high schools and elementary schools; and for schools serving white and minority low-income families vs. those serving high-income families and those serving middle-income families.

Note for Readers New to this Series

This is the third interim report from the National Survey of School Uses of Microcomputers. The results presented are based on data from 1,082 microcomputer-using schools, representing 68% of a nationally representative sample of about 1,600 microcomputer-owning public and non-public elementary and secondary schools. These schools, having one or more microcomputers for use by teachers or students, were surveyed between December, 1982 and March, 1983. Some data (e.g., whether the school had a microcomputer) was obtained from 98% of the full sample of over 2,200 schools, including about 600 schools that did not have a microcomputer.

The first two issues in this series--dated April, 1983; and June, 1983--presented basic data on the number and uses of microcomputers in schools, changes over time in how schools are using micros, the number of student and teacher users, the amount of actual use schools made of their equipment, and the amount of time that an average student user had access to a microcomputer during an average week.

Micro Ownership: The Least Likely and the Most Likely Schools

A majority of schools in the United States (53%) had at least one microcomputer by January, 1983. In all categories of secondary schools that we examined--whether urban, suburban or rural; low-income or high-income students; minority or white; public or private; large or small--a majority had at least one micro. Consequently, only among elementary schools are there groups of schools where a majority do not yet have microcomputers.

Elementary Schools in the South and Parochial Schools Are Least Likely to Have a Micro. Southern elementary schools and elementary schools with a religious affiliation tend to be among the poorer and most traditional schools in the country. Not surprisingly, schools in these sectors are also less likely to have a microcomputer. Whereas 46% of public elementary schools had one or more micros as of January, only 25% of parochial elementary schools did. Whereas 48% of the elementary schools outside the South had a micro, only 29% of those in the South had any. The other three regions of the country differed by only seven percentage points, with the Western U.S. states leading the way among surveyed schools with 51%.

Elementary schools in our low Socio-Economic Status (SES) category (the 26% of schools with the lowest family incomes in our survey) and schools serving a predominantly minority student population are also

Table 1: Elementary Schools Least Likely to Have a Micro
(Sample N's less than 40 are noted in table.)

Non-public Elementary Schools in the South.....	11%	(N=33)
Southern Elementary Schools in Central Cities of SMSAs.	18%	
Catholic Elementary Schools across the U.S.....	24%	
Non-public Elementary Schools in the West.....	25%	(N=33)
Elementary Schools in Rural Counties in the Northeast..	25%	(N=31)
Elementary Schools in Rural Counties in the South.....	28%	
Parochial Elementary Schools Other than Catholic.....	29%	

less likely than others to have a microcomputer (31% and 34% respectively). Enrollment is also a major factor: 33% of elementary schools with less than 200 students had a micro as of last January; 55% with more than 700 students had at least one. Table 1 shows other categories of schools where less than 30% of the schools in the sample owned a microcomputer as of January, 1983. Although the absolute percentages of schools having micros have no doubt changed since January, 1983, the relative rankings probably remain much the same.

Groups of elementary schools in our sample with the largest proportion having a micro include public schools in the Western states (57%), schools in rural counties in the Midwest (60%) and West (59%), and schools serving upper-income families (57%). (This "high SES" category covers the 24% of schools with the highest family incomes.)

Ownership of a Microcomputer Is Almost Standard Among Some Groups of Secondary Schools. The category "secondary schools" in this survey includes middle schools (grades 6-8) to senior highs. Because grade level and size are about equally associated with having a microcomputer, larger middle- and junior-highs (schools with more than 700 students) are almost as likely to have one as are smaller high schools (78% vs 80%). Among all secondary schools, junior highs under 700 students have the lowest microcomputer ownership rates (59%) and senior highs above 700 students have one of the highest rates (89%). In secondary schools with enrollments of over 1200 students, 91% have at least one microcomputer. Ownership is also nearly standard in two categories of secondary schools in the Northeast: public schools (88%) and suburban schools (89%). The rate is also high nationwide among high SES secondary schools (86%).

The secondary schools least likely to have a microcomputer are low SES schools (63%), predominantly minority schools (64%), and Southern rural schools (64%)--but not Southern urban schools. Public and non-public secondary schools, unlike at the elementary level, are about equally likely to have a micro.

Junior Highs and Middle Schools Have Different Patterns than Other Secondary Schools.

Our earlier reports showed that secondary schools have more microcomputers than elementary schools, make a somewhat greater use of them, and use them in different ways. The earlier reports, however, did not distinguish between schools serving older students and those serving younger adolescents. Here we address the question of whether the patterns for schools enrolling 7th and 8th grade students are more similar to high schools or to elementary schools. That is, where do we begin to see dominance of programming activities over drill-and-practice applications and where do the longer access times for student users begin to appear--with the beginning of secondary schooling or not until high school?

Junior Highs Have a Poorer Ratio of Students to Microcomputers than High Schools

Table 2 compares secondary schools serving different grade levels on a number of dimensions of ownership and use of micros, the

first being how many microcomputers they have and how many students use them. The table examines four types of secondary schools: public high schools, non-public high schools, schools that serve grades 7 thru 12 (combination junior-senior highs), and junior highs and middle schools (grouped together). We use the term "junior high schools" to encompass middle-schools and others that enroll students no younger than 5th grade and no older than 9th grade.

The typical junior high has three to four microcomputers (median: 3.5) to serve a typical student population of about 700. The median student-to-computer ratio in junior highs with micros, 181 students per micro, is about equal to that of the typical elementary school (183:1). (The typical elementary school has half as many microcomputers, but also has about half as many students.) In contrast, high schools, particularly non-public high schools, and combination junior-senior highs, have much more favorable student-to-computer ratios than do junior highs. (88:1 and 125:1--See Table 2, row "B.')

High schools are also more likely to have a minimally satisfactory ratio--one micro for every 50 students. This ratio allows a school to provide one-fourth of its student body with 20 minutes of computer time every day, using its equipment four hours per day (allowing for transition time and inevitable slack). Whereas 18% of all micro-owning high schools have this 50:1 ratio or better, only 10% of micro-owning junior highs do.

Junior Highs Provide Broader Access but a More Cursory Exposure. Junior high schools provide microcomputer access to a greater number of students than do high schools. Typically 13% of the students at a junior high get some time on a microcomputer during an average week, slightly more than the 11% that do so in high schools. Exception: non-public high schools provide computer access to an even greater proportion of students (20%) than do junior highs or elementary schools (14%).

Junior highs provide this broader access, even though they have fewer

Table 2: Use of Microcomputers in Secondary Schools
(Universe: Secondary Schools with One or More Microcomputers)

	Public H.S.	Non-Public H.S.	Jr.-Sr. Combinatn.	Junior Hi/ Middle Sch
(A) Median number of micros....	5.3	4.0	5.0	3.5
(B) Median ratio of students per microcomputer.	125:1	108:1	88:1	181:1
(C) Median percent of students who use micro in a week....	10%	20%	13%	13%
(D) Median hours per week that students use micros.....	13.9	13.0	12.4	12.1
(E) Median minutes of use per week per student user..	60	45	53	30
(F) Percent Reporting "Intensive Use" of Micros...				
for Programming Instruction.	64%	59%	44%	32%
for Drill and Practice.....	11%	5%	6%	24%
by "Above Average" Students.	37%	32%	34%	34%
by "Average" Students.....	17%	8%	9%	7%
by "Below Average" Students.	6%	3%	10%	14%
(G) Percent of Schools Reporting "MUCH MORE" of the Following as a Result of Having Micros:				
Learning by "Above Average"...	28%	24%	21%	16%
Learning by "Average" Students	6%	10%	4%	4%
Learning by "Below Average"...	5%	3%	6%	12%
Students Doing Independent Work	20%	24%	22%	14%

microcomputers, by giving each user very little time on the computer during any given "turn." The typical micro user in a junior high school gets 30 minutes of access time per week--six minutes per day. This amount is half as much as the typical high school student user gets and not much more than the 24 minutes per week typical of elementary school student users.

Programming instruction, in particular, is much less frequently reported to be an "intensive" use of microcomputers at junior highs (32%) than at high schools (64%). More junior highs concentrate on programming instruction with students than K-6 elementary schools do (18%), but elementary schools more frequently report intensive use for drill-and-practice (22% vs. 14% for junior highs and 10% for high schools). BASIC is the language almost universally used in junior high programming instruction. Logo or Pascal, two more structured programming languages, are seldom used.

Junior high respondents are also somewhat less positive about the effects of microcomputers on their students. They less often report a major impact on students working independently than the high school respondents do, for example (14% vs. 21%). They are less likely to report that having a micro resulted in "much more" academic learning by "above-average" students (16% vs. 27%), or "much more" learning by average students (4% vs 7%). On the other hand, they are more likely to report "much more" learning by below-average students (12% vs. 5%).

In summary, use in junior high schools falls between the patterns found in elementary and high schools, but seems closer to the former. There is more programming instruction than drill-and-practice use in junior highs and the opposite is the case in elementary schools, but the total intensity of micro use in junior highs more nearly resembles that of K-6 elementary schools than it does schools serving older students.

Junior highs appear to be falling short of their expectations in computer usage. Based on data not shown in these tables, junior highs as a group are doing less programming instruction than they had planned and less drill-and-practice as well. The same is true for elementary schools but to a smaller extent.

Finally, one measure of overall success of the use of computers as an object of instruction is the degree to which students use micros on their free time before school, at lunch, and after school. Our survey shows that senior high schools tend to use their micro equipment during these periods more often than do either junior highs or elementary schools. Senior highs average 4.6 hours per week of micro use outside of class time--for each school-owned micro--while junior highs average 2.5 and elementary schools, 2.2.

Regional Differences in Ownership and Use of Micros in Elementary Schools

The Northeast: Micro-owning elementary schools in the Northeastern states--from Maryland and Pennsylvania up to Maine--do not use their equipment as intensively as do elementary schools in other parts of the country. Fewer schools in this area use their micros for more than 15 hours per week per machine and fewer teachers report that their micros are used "intensively" with below-average, average, or above-average students. (See the bottom row of Table 3.) Also, elementary schools in the Northeast generally provide access to micros to fewer students each week than do schools in other regions, particularly those in the Midwest and West. (See Table 3.)

On the other hand, students who do use micros in these schools often get a substantial amount of time on the computer. Fifty-one percent of the Northeastern elementary schools report that the average user gets

Table 3: Regional Differences in How Elementary Schools Use Micros
(Universe: Elementary Schools with One or More Microcomputer)

	Northeast	Midwest	South	West
At Least One Micro for Every 50 Students	14%	15%	11%	26%
At Least 20% of Students Use Micro In an Average Week	27%	58%	41%	54%
Micros in Use for More Than 15 Hours Per Week	21%	32%	26%	30%
Users Average More Than 30 Minutes Per Week Per Student	51%	17%	28%	35%
Teach Programming Using LOGO	11%	3%	0%	2%
Percent of Schools Reporting "Intensive Use" of Micros...				
for Programming Instruction	32%	20%	17%	26%
for Drill and Practice	16%	16%	26%	17%
by "Above Average" Students	21%	33%	34%	34%
by "Average" Students	3%	10%	18%	16%
by "Below Average" Students	4%	20%	13%	13%

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more than 30 minutes per week at the computer. This is more than twice the proportion of elementary schools in the other regions that report this much time per user. Possibly related to this divergent access pattern (fewer students using micros but for longer turns), schools in the Northeast use their micros more for teaching programming than as teaching aids for traditional subject-matter instruction.

The programming language Logo, although rarely used as of last January, is used more in the Northeast (11% of the micro-owning elementary schools provide 30 hours of instruction in Logo) than anywhere else.

The Midwest: Elementary schools in the Midwest (from Ohio through the Dakotas down to Missouri) spread their use of micros among a broad range of students. This region's elementary schools have the highest proportion of schools that give weekly access to micros to more than 20% of the student body. On the other hand, fewer Midwestern elementary schools give each user more than 30 minutes of use per week. Thus, many students use the equipment, but only briefly.

Like other groups of schools, intensive use is reported for above-average students more than for average- or below-average students. But, compared to other regions, a higher proportion of Midwestern elementaries provide below-average students with "intensive use" of micros. Midwestern elementary schools report about an even mixture of programming and drill-and-practice uses while urban Midwestern schools lean toward drill.

On the whole, Midwestern elementary schools, particularly those in rural areas, tend to have an extensive program of using microcomputers. More than in other areas, Midwestern elementaries focus on general computer literacy rather than intensive use by a select number of students.

The South: Elementary schools in the Southern U.S. (from Virginia and Kentucky down to Oklahoma and Texas) use microcomputers for drill-and-practice much more than do elementary schools in other regions, and they teach programming less often. This tendency is especially strong in Southern central cities.

Micro-owning schools in Southern metropolitan areas (cities and their suburbs) are less likely to have an adequate student-to-micro ratio, and a smaller fraction of students in these student bodies use their micros than is true in other metropolitan areas, even the Northeast.

In contrast to these more quantifiable data, teachers in Southern elementary schools are more likely than the average computer-using teacher to report that their micros

are used "intensively" with above-average, average, and below-average students.

The West: Elementary schools in the Western U.S. (Montana to New Mexico and west) display two distinct patterns of microcomputer use. (Thus the overall pattern, as shown in Table 3, is not particularly distinctive.) Schools in our sample that are located in Western cities most often allocate use of their micros to a small number of above-average students. Many of the big city Western elementary schools allocate more than an hour per user per week, and the overwhelming use of micros in these schools is to teach programming skills to these select groups of students.

Suburban and rural Western elementary schools have the best ratios of students-to-micros of any of the elementary schools in our survey, and they spread their use over a broad range of students. Rural elementary schools in this region are the only cluster of schools in the study where above-average students are no more likely to intensively use micros than are average or below-average students. Drill-and-practice is the preferred activity in these rural Western elementary schools.

Regional Differences Among Secondary Schools.

Regional and locational differences among groups of secondary schools were not as strong as at the elementary school level. The differences that did emerge include the following: secondary schools in the West are more likely to have a satisfactory students-to-micros ratio than elsewhere (23% have a 50:1 ratio or better; in contrast, only 10% of Southern secondary schools do). Midwestern and Western secondary schools use their micros more than Northeastern and Southern schools (40% and 44%, respectively, use them for more than 15 hours per week, as opposed to about 30% for the other regions). In these two regions, schools more often give access to a large proportion of students, and users more often get more than 30 minutes per week at the computer. Thus, on most measures, secondary schools in the Western states and the Midwest have more intensive programs of using their microcomputers than do secondary schools in the Northeast and the South.

Of course, these patterns are only geographic averages; there are very active programs of micro use in secondary schools in all regions of the country, and there are some schools in each region where micros are basically dormant. But these statistics show that secondary schools in the West and the Midwest tend to have more active programs with their micros than secondary schools in other regions.

In summary, we find a great many regional and urban-suburban-rural differences in the patterns of school uses of microcomputers. Many of these seem consistent with impressionistic data about how teachers in different parts of the country are responding to the possibilities and promises of microcomputers. Their presence reminds us not to generalize too far from our personal experiences--that schools in different parts of the United States are dealing with microcomputers in characteristically different ways.

Differences Between Two Low Income Groups of Students

The schools in our sample have been divided into four "socioeconomic" status groups based on rough estimates of the family incomes of the students in each school as reported by the principal. (Where this data was not available, school district level information was used.) In addition, we can divide the schools into those schools whose student bodies are predominantly white and those that are predominantly black or Hispanic or other minority. At the elementary school level, about 2/3 of the predominantly minority schools are also in the lowest of the four "socioeconomic status" (SES) groups of schools; also, about 1/3 of the

schools in the lowest SES group of schools are predominantly minority.

In spite of their rough economic similarity, low SES schools in our sample that are predominantly white have very different patterns of microcomputer use than do the predominantly minority schools (using all the predominantly minority elementary schools, regardless of SES---although as we said, 2/3 are from this same low SES group). The numbers of schools for this comparison is rather small; 32 predominantly minority elementary schools with micros and 38 low SES white elementaries, but the differences between these two groups are substantial.

Predominantly minority elementary schools use drill-and-practice activities much more than they use programming activities with their students. In contrast, low SES predominantly white elementary schools do programming with students much more often than they use their micros for drill work--even more than the highest SES elementary schools, which do slightly more programming than drills.

Secondly, predominantly minority elementary schools report intensive use by below-average students much more often than do other groups of elementary schools, whereas low SES predominantly white schools stand out in the frequency with which they report intensive use by above-average students. Table 4 presents the complete tabulations of this data.

Thirdly, although predominantly minority elementary schools report using their microcomputers for twice as many hours per week as do low SES white schools, the low SES white schools report that an average student user gets twice as much computer time during the week. Finally, low SES predominantly white elementaries are more likely to have a teacher on their staff personally knowledgeable about computers than are the predominantly minority schools.

Thus, there are clear differences between these two categories of schools--schools which are fairly similar in terms of gross economic characteristics. In minority commu-

Table 4
How is Race and Socio-Economic-Status Related to Micro Ownership and Use
(Universe: Elementary Schools with One or More Microcomputers)

	Predominantly WHITE Elem. Highest SES	Middle SES	Lowest SES	Predomnt. MINORITY Elem. *	ALL Elem.
Median ratio of students per microcomputer	155:1	183:1	192:1	215:1	183:1
Median percent of students who use micro in a week...	24%	22%	12%	13%	16%
Median hours per week that students use micros.....	10	13	10	20	11
Median minutes of use per week per student user.	24	22	35	18	23
Percent of schools having a "Computerist" teacher...	46%	33%	35%	14%	35%
Percent reporting "intensive use" of micros...					
for drill-and-practice....	13%	18%	9%	33%	18%
for programming instruction	21%	17%	49%	10%	23%
with "Above Average".....	24%	30%	51%	26%	31%
with "Average" Students...	14%	9%	22%	12%	12%
with "Below Average".....	16%	12%	10%	32%	14%

* Note: Two-thirds of the predominantly minority elementary schools have socio-economic-statuses that would place them in the "Lowest" SES category used for disaggregating predominantly white elementary schools.

nities, those elementary schools that do have microcomputers are trying to use their micros to bring up the achievement levels of their lower-performing students. In white communities of relatively less well-off families, schools appear to prefer to give access to micros primarily to their better-achieving students, providing them with some instruction in computer programming, and then allowing them to work independently, in a more informal and less teacher-directed structure, to master computer skills.

These are two very different approaches to using microcomputers in elementary schools with students from relatively less privileged backgrounds. Although the relative frequency with which these approaches are being tried happens to be associated with the racial characteristics of the student body, these contrasting patterns of use are indicative of two different philosophies regarding the appropriate role of today's microcomputer hardware and software.

On the one hand, some schools believe that by providing existing drill-and-practice software and mass-marketed micros to lower-achieving students, they can be helped to catch up to the other students through this computer-based instructional treatment. Such schools are trusting that the properties that advocates of computer-based drill claim for their method--increased student motivation, immediate feedback, and individualization of instruction--can be realized for the the participating students.

The other approach, which allocates microcomputers to the better-prepared students, assumes that the slower-learning students require more personal attention of professional teachers in order to master basic academic skills. By providing the faster-learning students with a challenge on which they can work independently for long periods of time, the teachers aim to prevent the classroom management problems that occur when a few students become bored with the slow pace of instruction.

This survey contains relatively little data to help determine which is the more effective way to use a few microcomputers in a generally low-achieving and poor elementary school, but these patterns of results may provide a focus for some important future research.

Next Issue

The next issue of this newsletter focuses on how schools decide to obtain microcomputers, and how the decision process and funding patterns are related to how schools use the microcomputers they obtain. Succeeding issues will focus on classroom and school arrangements for using microcomputers and how classroom instruction patterns may be affected by the presence of a microcomputer.

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School Uses of Microcomputers

Reports from a National Survey

Issue No. 4, February 1984

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The first three issues in this series presented basic data on the number and uses of microcomputers in schools, changes over time in how schools are using micros, the number of student and teacher users, the amount of actual use schools made of their equipment, the amount of time that an average student user had access to a microcomputer during an average week, and how ownership and use of micros varies by region, level of school, urbanization, area income levels, and race.

This issue focuses on the different patterns that schools have used over the past few years to obtain microcomputers: the initiative of a single teacher, the effort of a building principal, the role of parent-teacher organizations, the leadership of school district and other school administrative personnel, and financial assistance from special grant programs.

The newsletter presents data on how schools have changed over the past few years in the way they have obtained micros and how they organize their use by students. We also show that how schools obtain micros and who is responsible for implementing them are strongly indicative of which students use them, for what purposes, and with what consequences.

Altogether, the survey examined nine aspects of the process of acquiring and implementing a school's first microcomputer. Briefly, the nine are: Who first talked about it?, Who worked hardest to obtain funds?, Who most influenced the choice of micro?, Who decided how many to obtain?, Who planned how to use it?, Who chose teachers?, Who decided where the micro would be kept?, Who trained teachers?, and Who decided what software to obtain?.

Acquiring and Implementing Micros: The Most Important Participants

Before 1982, the initial impetus for obtaining micros most often came from a single teacher. More recently, administrators have been playing a larger role in initiating first purchases. In half of the schools that obtained a microcomputer before the 1981-82 school year, a particular teacher was the one who first brought up the idea of having a micro at the school. (See Table 1.) Since then, an individual teacher has been the initiator in only about 1/5 to 1/3 of the schools obtaining their first micro.

Instead, administrators more frequently initiate discussion of acquiring micros. Among schools obtaining their first microcomputer during the 1982-83 school year,

Table 1: Changes in Who Initiates Discussion of Getting a School Micro

Who First Talked About Getting Micro by Year School First Obtained One

Obtained First Micro	Elementary Schools thru 6/81	7/81- 6/82	7/82- 1/83	Secondary Schools thru 6/81	7/81- 6/82	7/82- 1/83
Who First Talked About Getting One?						
One particular teacher	50%	27%	20%	52%	32%	33%
Group of teachers	6%	8%	7%	18%	14%	15%
Principal	24%	33%	35%	13%	16%	13%
Other Administrators in school and district	21%	29%	35%	18%	35%	41%
Column totals	101%	97%	97%	101%	97%	102%

* Percents add to more than 100% because more than one category named. Percents add to less than 100% because occasionally other categories than teachers or administrators were named (parents, businesses, etc.)

administrators other than the principal were the initiators most often, particularly in secondary schools. The principal has played an increasingly large role in elementary schools obtaining their first microcomputer, but has never been a major influence in generating discussion about buying micros in secondary schools. (See Table 1.)

Similarly, the solo teacher is important but becoming less significant for other aspects of the acquisition process--working to obtain funds, deciding which micro to obtain, and determining how many micros to purchase at one time. For example, in 47% of the secondary schools obtaining their first micro by the 1981-82 school year, one teacher was named as the most important actor for all three of these parts of the acquisition process. But among secondary schools joining the micro ranks more recently, one teacher was identified in this way only 18% of the time.

Instead, it has been administrators--the principal and district administrators in elementary schools and a variety of school and district administrators in the older grades--who have done most of the work and made most of the decisions that have brought micros into so many schools in the last two years.

When schools acquire additional micros, parents and groups of teachers are more often involved. When elementary schools acquire micros beyond their first, this process is usually led by administrators, but it tends to involve more parents and more groups of teachers than the first acquisition did. The solo teacher is less a major actor at this point than when a school is getting its first computer.

For example, in 31% of those elementary schools that have acquired micros on at least two occasions, an individual teacher was named as the person or persons who most influenced which type of computer was first obtained. (Principals and other administrators were named about as often.) When these same schools made another purchase, an individual teacher chose the micro at only 9% of the schools. In contrast, a group of teachers made the selection of the first micro at only 6% of these elementary schools, but chose the micro most recently obtained at 22% of the schools.

Parents have become more influential primarily in initiating discussions to get additional micros and in working to get funding for them, but not in the choice of micros or their number, which is left primarily to school administrators and teachers.

In secondary schools, the pattern of change between the first and the most recent acquisition is similar--the role of the "one" teacher is reduced and that of other school people increased. However, parents are not initiators, as they are at elementary schools.

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The solo teacher is still important in the implementation stage. Although administrators generally take the leadership in obtaining school microcomputers--and in picking teachers who will use them and deciding where they will be put--teachers play a large role in planning how micros will be used with students, in selecting software, and in training teachers. Overall, a single teacher is more important in these phases than are groups of teachers, particularly in secondary schools. (See Table 2.)

Table 2: The One Teacher is Still Important in the Implementation Stages

Percent Naming Actor Category as Most Important at that Step

(School's first micro acquisition; selected categories only.)

	Elementary Schools			Secondary Schools		
	Actor Categories			Actor Categories		
Step of Process	One Teacher	A Group of Teachs.	All Admins.*	One Teacher	A Group of Teachs.	All Admins.
Plan How to Use Micro	34%	27%	29%	50%	27%	16%
Choose Teachers to Use	11%	19%	69%	20%	[illegible]	63%
Decide Where to Keep	16%	10%	70%	30%	17%	53%
Train Teachers to Use	38%	6%	35%	48%	15%	26%
Decide on Software	33%	30%	25%	47%	30%	18%

However, here too, over the past year or two, leadership roles are being shared more among teachers at the same school. For example, at secondary schools getting their first microcomputers during the 1980-81 school year, only 23% of the respondents indicated that planning for student use of micros was done primarily by a group of teachers. In contrast, among secondary schools getting their first micro two years later, 42% said that a group of teachers led the planning. During this interval, the proportion of secondary school respondents who named one teacher as the most important actor in the implementation stage declined from 65% to 43%. A similar pattern was found for elementary schools, except that the increase in importance of teacher groups was less significant than the increase in involvement of administrators. (See Table 3.)

Table 3: Changes in "Who Plans" for How Micros Should be Used

Most Important in Planning Micro's Use by Year School First Obtained (a)

Obtained First Micro	Elementary Schools 7/80-6/81	7/81-6/82	7/82-1/83	Secondary Schools 7/80-6/81	7/81-6/82	7/82-1/83
Who Planned Micro's Use?						
One particular teacher	48%	34%	25%	65%	41%	43%
Group of teachers	34%	23%	41%	23%	29%	42%
Principal and Other Administrators Only	22%	41%	34%	12%	29%	15%
Column totals	100%	98%	100%	100%	99%	100%

* See Note to Table 1.

The solo teacher has been most important in the West; administrators have been most important in the South. The solo teacher has been most influential in how schools obtain and use microcomputers in the Western states. Between 40% and 50% of micro-owning elementary and secondary schools in these states indicate that one teacher was the most important actor at each stage--talking about getting a micro, working for and organizing its purchase, and organizing how it would be used. In other regions, comparable percentages tend to be below 30%, particularly in elementary schools. (See Table 4.)

Administrators have played a much larger role in the South than in other parts of the country. In nearly 9 out of 10 micro-owning elementary schools in Southern states, the principal or another school or district administrator was the one who first talked about the school getting a microcomputer. In contrast, this was true in about 1/2 of the schools in the other regions.

Table 4: Most Important: One Teacher in the West; Administrators in the South

Person/Group Named Most Often in Given Types of Decisions

	Elementary Schools N.E.	Midw.	South	West	Secondary Schools N.E.	Midw.	South	West
Acquisition Decisions								
One Teacher	9%	20%	1%	42%	35%	30%	20%	46%
Administrators	56%	61%	88%	42%	44%	50%	72%	43%
Group of Teachers and Mixed Teach/Administr.	35%	19%	11%	16%	16%	20%	8%	11%
Implement Plan Decisions								
One Teacher	14%	18%	17%	45%	37%	36%	24%	56%
Administrators	54%	44%	48%	22%	20%	21%	34%	17%
Group of Teachers and Mixed Teachs/Administ.	32%	38%	35%	33%	43%	43%	42%	27%

Who Initiates and Organizes the Use of Micros is Correlated With Which Students Use Them and With How They Are Used

The relative influence of a single teacher, a group of teachers, the principal, and other administrators over how their school acquires and implements microcomputers is correlated with various ways that

micros are being used. Correlations for elementary schools are stronger and these are shown in Table 5.

In elementary schools in which a group of teachers leads the effort, micros appear to be most successfully used. In elementary schools whose first micro was acquired and implemented by a group of teachers, micros are in use for more hours of the week; their use by below-average, average, and above-average students is greater; the breadth of their use across a variety of computer applications is also greater, and a higher proportion of the school's students use micros during the week.

For example, at the typical elementary school where a group of teachers was largely responsible for implementing computer use, 43% of the school student body had some access to the microcomputers during an average week. In contrast, where principals, other administrators, or a single teacher were mainly responsible for implementation, typically only 15% of the student body used computers during any given week. Where a group of teachers led implementation activities, the micros were typically in use for 19 hours each week; nearly twice the 10 hours per week that was typical in elementary schools in which a single teacher or the school principal took the major responsibility for organizing how the school's first micros would be used.

Where a single teacher dominates acquisition and implementation in elementary schools, micros sit idle more often and, when used, they are used primarily to teach computer programming and with faster-learning students. The correlations in Table 5 between the overall influence of "one teacher" and measures of student microcomputer use are predominantly negative. They are negative for "hours per week micros in use," for "use by below-average students," "use by average students," and for two measures of "time of use" for those who do get to use the equipment. This means that, generally speaking, the more a single teacher was responsible for initiating discussion, obtaining equipment, and organizing its use in an elementary school, the less use was subsequently reported for the equipment at the school.

This lower use is in spite of the fact that schools where a single teacher dominated the acquisition and implementation processes tend to have a better ratio of students to microcomputers than do other schools. At a typical elementary school where implementation was led by a single teacher, there are a little more than 100 students per microcomputer. In contrast, there are nearly 200 students per microcomputer at other elementary schools.

Above-average students get relatively more micro use at schools where a single teacher did most of the implementation of the school's first micro. In elementary schools, all groups of students we examined use micros less when only a single teacher was involved in implementing its use. But "above-average" students, who tend to get more use of school computers than other students, appear to get an even larger share of computer time at schools where a solo teacher played a dominant role.

Table 5: How Micros Are Used in Elementary School is Correlated with the Importance of Teachers and Administrators During Acquisition/Implementation

(Correlation coefficients above .09 are shown)

Outcome	Index of importance during acquisition/implementation of... One Teacher	Group of Teachers	Principal	Other Admins.
Hours per week micros in use....	-.17	+.14	-	
Use by above-average students...		+.18		-.20
Use by average-achieving students	-.15	+.19	+.11	
Use by below-average students...	-.21	+.17		+.25
Use for programming instruction.	+.29	-.10		-.34
Use for drill-and-practice.....	-.12		+.10	
Average across 13 applications..	-.10	+.23		
Percent of students using.....		+.19		..
Time of use by each programming student.....	-.23			
Time of use by each drill user..	-.16		+.21	
Relative use for programming rather than drill-and-practice	+.28	-.12		-.26

* A NEGATIVE correlation (e.g., -.18) indicates that in schools where that actor plays a larger role, there tends to be LESS use in that respect (e.g., fewer hours per week). A POSITIVE correlation indicates that the larger the role of that actor the MORE use in that respect (e.g., more hours per week). Correlations above .09 are statistically significant (for this sample size at the .05 level; correlations above .20 may be considered "substantial."

Table 6: How Much Regular or Intensive Use of Micros in Various Implementations

Type of Use	Most Implementation Decisions Made by...					
	One Tchr.	Group of Tchrs.	Adminis-trators	One Tchr.	Group of Tchrs.	Adminis-trators
	Elementary Schools			Secondary Schools		
	Percent of schools with regular or intensive use with...					
Above-average students	66%	100%	72%	86%	76%	62%
Average students	59%	92%	58%	69%	70%	58%
Below-average students	41%	83%	58%	33%	42%	50%
Ratio: above-average % to below-average %	1.6	1.2	1.2	2.6	1.8	1.2
Drill-and-practice programming instruct'n	47%	75%	55%	23%	21%	40%
	74%	39%	38%	87%	81%	57%
Ratio: programming use to drill/practice use	1.6	0.5	0.7	3.8	3.9	1.4

Table 6 shows how schools grouped by the dominant actor in the implementation process (from "planning use" to "obtaining software") are using their microcomputers. The percentages shown are the percentage of schools that reported a particular use was "regular" or "intensive" at their school.

The first and third rows of the table compare the computer access of "above-average" vs. "below-average" students at different kinds of schools. The table shows that 66% of the elementary schools where "one teacher" provided the leadership report regular or intensive use of micros by <u>above-average</u> students. But only 41% of the same schools report regular or intensive use by below-average students. These two numbers represent a ratio of 1.6 to 1 (66% vs. 41%). The ratios of above-average students' use and below-average students' use in the two other groups of elementary schools--those where groups of teachers or administrators did the implementation--are both only 1.2 to 1. Thus, in these latter schools, there is more of a parity between the use made of the micros by above-average and below-average students.

In secondary schools, "above-average" students actually are <u>more</u> likely to be regular or intensive users of micros where a single teacher was the dominant leader than they are in other kinds of schools. Thus, in this situation, they not only have a "relative" advantage over lower-ability students, but an "absolute" advantage as well. That is, above-average secondary school students have a greater computer involvement in schools with a dominant individual teacher than when groups of teachers or administrators take responsibility for organizing computer use--a pattern not the same for any other group of students at either the elementary or secondary levels.

Thus, at both elementary schools and secondary schools, but particularly in the higher grades, when administrators take a major role in deciding how acquired microcomputers are actually used, below-average students are much more likely to achieve parity of access to microcomputers in comparison with above-average students.

Whether equal allocation of computer time across various ability groups is the most beneficial allocation depends on whether computer-based learning activities are as helpful for the educational needs of below-average students as they are for above-average students. That is, an optimal allocation of resources would consider factors such as equity but also the effectiveness of providing instruction through the medium of the microcomputer as well. A survey such as this can only raise these more fundamental questions, not answer them.

Programming activities are favored by "single teacher" implementers in elementary school and teacher implementers in general in secondary schools. Elementary schools with a single dominant teacher in computer implementation differ markedly from other elementary schools in how much they use computers for programming instruction compared to their use for drill-and-practice. Table 6 shows that "one dominant teacher" elementary schools are about 1.6 times as likely to provide regular or intensive programming instruction as they are to provide regular computer-based drill activities. In contrast, administrator-led implementations at elementary schools result in regular programming instruction only about 0.7 times as often as regular drill-and-practice use. And where groups of teachers dominate the implementation process the ratio of programming to drill uses is only 0.5 to 1.

At secondary schools, the contrast between programming and basic skills practice is primarily between teacher-organized implementations (whether one dominant teacher or a group of teachers) and administratively-organized implementations. Regular programming activities are about four times as frequent as basic skills practice activities in teacher-led implementations, but they are only 1.4 times as frequent where administrators do most of the implementation.

Sources of Funding for School Acquisitions of Microcomputers

Schools have relied upon special funding sources for about half of their acquisitions to date. The largest single source of funds for the microcomputers that schools have acquired (through January, 1983) is special grants obtained by the school or school system. This includes federal funds in the form of allocations to states and districts and state money in a variety of forms. About one-third of the schools with microcomputers report that a substantial portion of the cost of their microcomputer equipment came from such grant sources--see Table 7. ("Substantial" means "more than 40% of all hardware expenditures.") Grant funds have provided more computers to schools than have general school system funds and more than school and departmental sources combined.

Another important external source of funds--but only at the elementary school level--has been fund-raising activities and contributions from parent-teacher associations. This has been a substantial source of funding at almost one-quarter of micro-owning elementary schools, although it has been a factor at the secondary school level only rarely. Other contributions of money and computers have been important in only a few schools.

Grant money has enabled "lower-middle" income schools and minority and rural elementary schools to have microcomputers. Grant money and P.T.A. fund-raisers have been a much more important source of funding for computer equipment at some kinds of schools than at others. Possibly stemming from recent changes in the way federal funds have been allocated to education, the survey data show, rather unexpectedly, that schools outside of metropolitan areas were among those which most extensively have relied on special grant money in order to acquire microcomputers.

Forty-three percent of rural and small-town schools used grant money to obtain a substantial portion of their microcomputer hardware. In comparison, for example, 27% of schools in the suburbs of metropolitan areas and only 7% of central city elementary schools used grant money this extensively. (Of course, some respondents may have attributed grant-obtained equipment to other sources--for example, to bureaucratic departments within large city school systems.)

With the exception of predominantly minority elementary schools--which do make use of grant

Table 7: Sources of Funding for School Microcomputers (Two Measures)

	Percent of Schools Using This Source for More Than 40% of Acqusition Expenditures		Estimated Average Percent of School's Expenditures Coming From This Source	
	Elementary	Secondary	Elementary	Secondary
Grant funds	30%	36%	29%	34%
General School System	25%	32%	23%	30%
PTA and Fund-raising	22%	5%	19%	4%
Principal's Funds	13%	11%	11%	11%
School Department Funds (may incl. system dept)	12%	17%	10%	17%
Contributions of Money and Equipment.....	6%	4%	8%	4%

sources more than any other demographically defined group of schools--in general it is neither the poorest schools nor the wealthiest that have been able to take advantage of grant sources to fund computer acquisitions, but rather those schools serving a "lower-middle income" quartile of schools. For both elementary and secondary schools, a much higher proportion of predominantly white lower-middle income schools received a substantial fraction of their computer funding from grants than did other income groups of predomiantly white schools.

Grants do seem to have some equalizing effect, though--schools in the upper-quartile of average family incomes were the least likely to use grant money for a substantial portion of their computer acquisitions. Of course, computer expenditures in these wealthier schools are larger to begin with, so even a small percentage of acquisitions through grants adds to their overall advantage.

PTAs are important sources of funds in elementary schools where both principals and groups of teachers have participated in acquiring and implementing micros. The primary characteristics of elementary schools in which PTA's have funded computer acquisitions are that the effort to obtain microcomputers is totally and broadly based at the school, and that the school principal plays a major leadership role. Where school district administrators were involved in obtaining the school's first microcomputer, PTA support and local school fund-raising are still relatively negligible. Where a single teacher made most of the initial buying decisions, he or she rarely involved the PTA. But in schools where either groups of teachers or the school principal (or both) were the ones who first talked about getting a computer, and where they were active in obtaining the equipment and in deciding how it would be used, between one-third and one-half have used PTA and local fund-raising activities to finance much of their acquisitions.

Central city and predominantly minority elementary schools have done this somewhat more often than other groups of elementary schools, while elementary schools in the Western U.S. have used this method of financing less frequently than others.

Highly involved secondary school administration and staff are more able to find funds for their computer acquisitions within regular school and school district budgets. At the secondary school level, principals and teachers active in initiating acquisition of microcomputers typically go to sources other than PTAs to finance their acquisitions. Secondary school principals who play a leadership role in acquiring a microcomputer may use a variety of

funding sources, but about one-third primarily limit themselves to money in budgetary categories under their own control. Where an individual teacher is behind the drive to acquire a computer for the school, funds allocated within the school on a departmental basis are more often made available than where the leadership comes from administrators or from groups of faculty members. When groups of teachers are the ones who first talk about computers and take the lead in organizing their use once obtained, they tend to go to sources of funding outside their own particular school but within regular budgets of their school system.

Secondary schools that obtain computer funding in various ways use their equipment similarly. Schools that rely primarily on their own school and departmental budgets and local contributions tend to have a poorer (higher) ratio of students per computer than do schools that obtain district or grant funding. This is true for both elementary schools and secondary schools--see Table 8, left- and right-panels, respectively. One might expect, therefore, that schools with external funding sources also are able to put their equipment to greater use. In general, this does not appear to be so, particularly at the secondary level.

Actually, among secondary schools, computers appear in some respects to be used more intensively in schools where principal and department funds provided most of the school's equipment than where outside funds are heavily involved. For example, the computers at principal-funded and department-funded secondary schools are typically in use for a few more hours per week (17 hours and 15 hours, respectively) than those in schools funded by grants and school system resources (12 hours and 14 hours).

Nevertheless, departmental acquisitions do tend to narrow the base of students that have access to micros. Only 8% of the school's students used micros during an average week at a typical secondary school relying on departmental acquisitions, in comparison to percentages like 10%, 13% and 14% at other groups of secondary schools. (See Table 8.) Also, schools with department-acquired computers are more likely to be dominated by programming activities than other secondary schools. (82% report regular programming activities; only 20% report regular drill-and-practice uses.)

Overall, though, most of the measured outcomes shown in Table 8 are fairly similar among secondary schools with different funding sources.

Table 8: How Micros are Used is Related to their Major Source of Funding

	Schools Categorized by their Major Source of Funding							
	Elementary Schools				Secondary Schools			
Measure of Use	Grants	PTAs & Fund-Raisers	Principal	School System	Grants	Departments	Principal	School System
Median ratio of students per micro at these schools	154:1	192:1	233:1	145:1	112:1	142:1	175:1	125:1
Median hours per week each micro is in use.....	10	11	8	13	12	15	17	14
Median percent of students using micro during week..	29%	20%	16%	18%	10%	8%	13%	14%
Percent with regular or intensive use..								
for programming.....	33%	63%	30%	40%	70%	82%	63%	79%
for drill-and-practice	67%	73%	43%	58%	34%	20%	31%	34%
by above-average stu..	75%	79%	70%	88%	78%	73%	75%	84%
by average students	75%	73%	50%	79%	60%	74%	62%	74%
by below-average stu..	73%	60%	23%	74%	43%	33%	35%	36%

Among elementary schools, there are major differences in use patterns between schools that have depended upon the principal's own sources of funding and those that have used PTA contributions and fund-raising activities to support their acquisition of micros. Where the principal had to provide most of the financial support for micros from general school funds, the equipment is used less often and by fewer students than when either outside funding or local fund-raising was used to acquire them.

In particular, "principal-funded" elementary schools provide much less opportunity to below-average and average students to use micros than do other micro-owning elementary schools. (See Table 8, left-panel.) In contrast, schools that had PTA sponsorship of their acqisitions are about average on various measures of computer use, and they strongly emphasize using their micros to teach children how to program computers. Elementary schools using grants to fund their purchases tend to involve the greatest proportion of students in computing activities, and those that used school system general funds average the greatest number of hours of use.

Teacher Evaluations of Impact Vary by Acquisition and Implementation

This survey contains relatively little hard evidence about how students are actually profiting from their turns at a microcomputer. We do have the opinions of the teachers responsible for computer use at each school; and just as we rely on these informants for information about which students use their school's computers, for how long, and for what purposes, we also rely on these teachers for clues concerning what impact the computer has had on their school and their students.

Teachers responding to our survey were asked to evaluate the impact of having micros at their school on a number of outcomes: student enthusiasm for school, the amount of help students offered one another, how independently they worked, the extent to which student assignments were individualized, and how much overall learning was attributable to computer-based instruction--for below-average, average, and above-average students.

At both major levels of schooling, but particularly at the elementary level, the respondents differed in their answers to these questions according to who dominated the implementation of the first microcomputer--an individual teacher, a group of teachers, the principal, other administrators, or a mixture of teachers and administrators. Their evaluations also differed according to who first talked about obtaining a micro and according to how their first micro was obtained.

In contrast, schools with different sources of funding did not differ, except in one respect, in their evaluations of the impact that micros have had on their school. (The one funding difference we found is that where elementary schools obtained PTA funds for their micros, student enthusiasm and independent student learning activities were both reported to be higher because of micros than where grant money or other school system sources funded a school's acquisition of micro equipment.)

Table 9 summarizes the evaluations of computer-using teachers in elementary schools by grouping schools according to the "dominant actor" when the school acquired and implemented its first microcomputer. Each row in the table represents the respondents' evaluations on a particular outcome.

There are three entries in the table for each "dominant actor-outcome" combination. The first is the average response from schools where that actor was the one who first talked about getting a microcomputer. The second entry is for those (heavily overlapping) schools where that same actor made most of the acquisition decisions; and the third

Table 9: Acquisition/Implementation Leadership and Experienced Outcomes: Elementary Schools

"+" : Significantly more positive mean outcome than "-" groups
"-" : Significantly less positive mean outcome than "+" groups
"0" : Significantly more positive outcome than "." groups and significantly less positive than "+" groups
"." : Not significantly different mean outcome than either "-" or "+" groups

* Significance measured at .05 level by Student-Newman-Keuls a posteriori contrast test.

Experienced Outcome	Dominant Actor at that Stage (Talk; Acqu.=acquire; Impl.=implement)														
	One Teacher			Group of Teachers			Mixed Tchrs/Admins			Principal			Other Administrators		
	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.
Student enthusiasm for school	.	−	.	.	.	−	.	+	.	.	+	+	.	−	.
Mutual assistance among students	−	.	+	.	.	+	+	.	+	−	.	+	−	.	−
Students working independently	−	−	.	.	+	.	+	.	.	0	+	.	0	+	.
More individualized learning tasks	−	−	−	.	.	−	.	+	−	0	+	+	+	+	.
Learning by below-average stu.	−	−	−	.	0	.	+	+	+	0	0	+	+	+	+
Learning by average students	−	−	−	.	+	.	+	+	+	.	+	+	0	+	.
Learning by above-average stu.	−	−	−	+	+	−	+	+	+	+	+	+	+	+	.
Outcomes significantly more positive than some other groups	0	0	1	1	3	1	5	5	4	1	5	6	3	5	1
Outcomes significantly less positive than some other groups	6	6	4	0	0	3	0	0	1	1	0	0	1	1	1

entry summarizes the evaluation at schools where that same actor led the implemention effort.

The table entries contain only a single code, usually "+" or "-". A "+" entry in the table indicates that those schools, as a group, reported a (statistically) significantly more positive impact on the outcome in question (e.g., improving student enthusiasm) than did the schools grouped as "-" on that outcome. "Dominant actor-outcome" combinations with a "." entry were not statistically different from either the "+" or "-" groups. (The few groups labelled "0" were significantly more positive than the "-" groups and less positive than the "+" groups.)

<u>Almost without exception, elementary school teachers who report that a SINGLE teacher (in many cases, themselves) played the dominant role in talking about, working for, or implementating their school's first microcomputer also report that their micro(s) have had a LESS positive impact on a variety of student outcomes than do other elementary school respondents.</u> As shown in the first column in Table 9, respondents at schools where "one teacher" was the first to speak up for acquiring microcomputers reported less favorable outcomes than some or all other groups of elementary school respondents on six of the seven outcomes we asked about. The results were similarly unfavorable for elementary schools where a single teacher had the responsibility for making most of the acquisition decisions. Only with respect to implementation activities did individual-teacher-led elementary schools do significantly better than any other group of elementary schools, and that was for one outcome (student enthusiasm) and only in comparison to one other group--schools where administrators other than the school principal handled most of the initial implementation of micros.

For example, using figures that helped make up the summaries in

Table 9, 16% of elementary schools where a single teacher first talked about getting micros reported that above-average students were learning "much more" as a result of the school's having micros. In comparison, 36% of the schools where the principal was the one who first discussed buying micros reported a similar effect for above-average students.

For increased learning by below-average students, the most impressive comparison is between schools where the first person who talked about micros was an individual teacher (only 1% of these schools reported "much more" learning by below-average students) and where the initator was an "other administrator" (usually a district specialist). Nineteen percent of these schools reported "much more" learning by below-average students.

At the implementation stage, elementary schools where an individual teacher was responsible reported much less favorable outcomes than where the principal handled most of the implementation or where a combination of administrators and teachers did. For example, 7% of "single-teacher-implementing" elementary schools reported that students were now given tasks much more appropriate to their own ability level, but 32% of "principal-implementing" schools reported this outcome. None of the individual-teacher-implementing elementary schools reported "much more" learning by "average" students, but 11% of the schools where both administrators and teachers were heavily involved in implementation reported this outcome.

Overall, the best outcomes among elementary schools were reported by schools (1) where the initial idea of obtaining a micro involved participation of both the principal and teachers, (2) where decisions about what and how many micros to acquire and efforts to obtain funds involved just about any combination of actors except a single teacher acting on his or her own, and (3) where the implementation effort was handled primarily by the school principal, or by the principal with assisting teachers.

A group of teachers acting without principal involvement tended not to do as well as even the principal acting alone. For example, only 15% of elementary schools where a group of teachers did most of the implementation reported "much more" student enthusaism as a result of micros, but 40% of the respondents from "principal-only-implementing" elementary schools reported such an increase, as did 40% of schools where implementation was led by a mixture of principal and teacher involvement.

Similarly, where only teachers handled implementation, there was a significantly lower impact on above-average students--those who were typically said to profit most from micros--than where principals and teachers worked on the implementation together.

<u>Fewer evaluation differences emerged from the secondary school data.</u> At secondary schools, there were far fewer differences in reported outcomes according to the involvement of different actors in the acquisition and implementation process. The statistically significant differences that did appear primarily involved two outcomes: individualization of learning tasks and learning by below-average students--see Table 10.

In secondary schools where administrators <u>other than the principal</u> initiated discussion, obtained the equipment, and organized its use, there was a significantly more positive impact on these two outcomes than where a single teacher or the principal initiated discussion or where a single teacher obtained the equipment or organized its use. The primary reason for these significant differences is that secondary schools where the initial acqisition and implementation of micros was handled by "other administrators" have used their machines much more for remediation efforts with below-

Table 10: Acquisition/Implementation Leadership and Experienced Outcomes: Secondary Schools

(Notes for Table 9 apply to this table also.)

Dominant Actor at that Stage (Talk; Acqu.=Acquire; Impl.=implement)

Experienced Outcome	One Teacher			Group of Teachers			Mixed Tchrs/Admins			Principal			Other Administrators		
	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.	Talk	Acqu.	Impl.
Student enthusiasm for school	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Mutual assistance among students	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Students working independently	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
More individualized learning tasks	—	—	•	•	•	•	•	•	•	—	•	•	+	+	•
Learning by below-average stu.	—	•	—	+	•	+	—	•	0	—	•	•	+	•	+
Learning by average students	—	•	•	•	•	•	•	•	•	—	•	•	+	•	•
Learning by above-average stu.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Outcomes significantly more positive than some other groups	0	0	0	1	0	1	0	0	0	0	0	0	3	1	1
Outcomes significantly less positive than some other groups	3	1	1	0	0	0	1	0	0	3	1	0	0	0	0

grade-performing students than other secondary schools.

Still, secondary schools where groups of teachers are involved in the initial discussions and in implementation, although they may use micros more heavily for programming instruction and primarily with average and above-average students, also report relatively high impact on below-average students (in comparison with other schools).

With secondary schools as well as with elementary schools, it appears that where an individual teacher was the clearly dominant actor when the school obtained its first microcomputers, the school still retains an orientation of serving a narrow student population, without compensating for this by any more impressive outcomes for the above-average achieving students who are their primary beneficiaries.

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